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Shoreline Erosion and Proposed Control at Experimental Facility 15–Spesutie Island

by Todd Brinkman

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Weapons and Materials Research Directorate, ARL

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14. ABSTRACT Shoreline erosion at Experimental Facility 15, Spesutie Island, at Aberdeen Proving Ground, Maryland, has been an ongoing problem—especially within the last few years. Tides, storm surge, and increased boat-testing traffic have each played a major role in the erosion of the shoreline to the rear of the facility. Proposed plans are currently in progress to remedy this problem as soon as possible.					
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1. Introduction

Coastal erosion is the wearing away of land and the removal of beach or dune sediments by wave action, tidal currents, wave currents, drainage, or high winds. Waves, generated by storms, wind, or fast-moving motor craft, can cause coastal erosion, which may take the form of long-term losses of sediment and rocks or merely the temporary redistribution of coastal sediments; erosion in one location may result in accretion nearby. The study of erosion and sediment redistribution is called “coastal morphodynamics”. It may be caused by hydraulic action, abrasion, impact, and corrosion.¹

The tidal shorelines of the Chesapeake Bay Estuary system are an important resource. The interface between the land, air, and water defines the wetted perimeter where land use and clearing practices have taken on an adversarial role with regard to the management and conservation of marine resources. Because of natural occurrences such as ground-water seepage, the rise and fall of the tide, wave action from storms, and rain-generated ground surface runoff, the shoreline is in a constant state of change.

The most active changes occur where wave action against the shore is most intense. Shoreline erosion is the result of this wave activity: the local wave climate. The highest rates of shoreline erosion occur along the shorelines of the main stem of the Chesapeake Bay where the fetch exposures are the greatest. The fetch is a length of water over which a given wind has blown.

2. Methods

Methods to combat shoreline erosion include, but are not limited to the following: bulkheads, stone revetments, groins, beach nourishment, breakwaters, establishment of marsh fringes, and/or any combination of the aforementioned. Traditional methods to abate shoreline erosion include the use of wood bulkheads and groins as well as stone revetments. More recently, the use of beach-fill marsh grasses and offshore breakwaters and sills have increased for a wide variety of reasons, mainly financial, environmental, and personal preference.

Historically, addressing shoreline erosion has been done in a haphazard fashion without a basic understanding of the logistical, environmental, and financial parameters necessary to achieve a solution to the problem. It is at this point that we find ourselves needing to assess what is being done along the shores of the bay with regard to erosion and an eye toward water quality and habitat preservation as well as coastal hazards and property loss.

Experimental Facility 15 (EF 15) is a US Army Research Laboratory (ARL) facility located on the west leg of Spesutie Island at Aberdeen Proving Ground (APG), Harford County, Maryland, located near the head of the Chesapeake Bay. The island is 1500 acres of mainly tidal marsh and small tributaries with some forested acreage. It is joined to the mainland of APG at Woodpecker Point by a small causeway approximately 1/8-mi long. EF 15 is bordered on 3 sides by either tidal marsh or forested or maintained acreage and bordered on the remaining side by Spesutie Narrows waterway. Spesutie Narrows bounds the island on the west and the bay bounds it on the north, east, and south. The highest elevation of Spesutie Island is 3 ft (0.9 m).

3. Assumptions

Within the last few years, EF 15 has endured significant damage to its shoreline. With the elevation of Spesutie Island being so low, it is easy to imagine that the effects of the climate, natural phenomena, and man-made phenomena have taken their toll on this low-lying piece of real estate. The rear of the facility, toward Spesutie Narrows, is crushed rock hard stand with approximately 30–40 ft of manicured lawn to the shoreline. There are no trees on the range proper, with only a smattering of indigenous vegetation lining the water's edge. Over this short period of time 15–18 ft of the shoreline has been lost because of this; as a result, it is losing its hold at a very rapid pace.

Because of its makeup (i.e., soil, sand, and rock composition), a lack of shoreline vegetation, weather, locality, and any type of erosion abatement, the shoreline continues to be at the mercy of the elements. This report addresses the steps taken to counter the effects of both natural and man-made erosion to the shore in hopes of a complete and restorative remediation plan.

Wave currents, particularly in the winter months, have a tremendous effect on the landscape of facility. Tidal or storm surges raise the water level to a point that the shoreline and lawn is completely submerged to the hardstand at the rear of the facility. These powerful tides wreak havoc on the shoreline, taking a small part of it with every outgoing tide and leaving undesirable items in its wake. Undermining of the shoreline has also become a problem, not only from an erosion standpoint but from a personnel safety standpoint as well.

Located on the East side of Spesutie Narrows is the mainland of APG. Like Spesutie Island, it is made up of various facilities and ranges designed for weapons testing as well as automotive testing. These ranges belong to the Aberdeen Test Center. Directly across Spesutie Narrows is the Amphibious Landing Facility. Many test scenarios are performed from this facility in the Narrows, specifically military boat

operations. Some of these boats are large in size and operate at high speed, resulting in a large wake from the back of the boat. This is what was previously referred to as a man-made phenomenon. These resulting wakes, depending on where the boat is operating within the Narrows, continually pound the shoreline on the opposite shoreline contributing to the effects of erosion and its slow destruction.

4. Procedures

After noticing the effects of all of the aforementioned contributing factors, an initial plan was set in place to stop, or at least minimize, the erosion at the facility by way of a break wall constructed from concrete blocks (Fig. 1). The ARL Environmental Research Group (ERG) was called out to see firsthand what was taking place and to measure and assess the extent of damage to the shoreline. First and foremost, the ERG was required to submit a Record of Environmental Consideration (REC), APGR 200-1,² and also a site plan before any work was to be initiated. The REC (Fig. 1) is shown on the next page followed by a picture (Fig. 2) showing damage to the shoreline with the proposed placement of the break wall.

REC'D
17 OCT 16
(3)

RECORD OF ENVIRONMENTAL CONSIDERATION (REC)
APGR 200-1

EF-15 break-wall

ARL
AR000087J

1. TITLE: Shoreline Break-wall at EF-15

2. DESCRIPTION OF PROPOSED ACTION AND LOCATION (INCLUDE A MAP SHOWING SITE OF THE PROPOSED ACTION):

Proposed activity is to provide labor, materials and equipment to create a shoreline break-wall at EF-15. Over the past 3 years the EF-15 facility has lost approximately 15 feet of shoreline property and habitat due to wave action from the Spesutie Narrows. Proposed action is to place concrete blocks measuring 3' long by 3' wide by 2 foot tall approximately 10 feet from the current shoreline. The blocks will be stacked 2 high for a length not to exceed 100 feet. There will be 6 inch gaps between the blocks to allow water to flow through and prevent back wash issues. EF-15 is located on the west leg of Spesutie Island. Project will be ARL funded and executed. Please find attached pictures of erosion and proposed wall site.

3. START DATE AND END DATE OF PROPOSED ACTION: 5 October 2016 thru 5 October 2018

4. After reviewing the screening criteria it has been determined that the action (Choose One)

a. Is adequately covered in the existing EA ☐, EIS ☐, CERCLA Document ☐

(Title and Date) _____

b. Qualifies for Categorical Exclusion (CX) C-1, D-2, G-1 Appendix B, AR 200-2.

c. is exempt from NEPA requirements under the provisions of (cited superseding law): _____

d. requires an Environmental Assessment (EA) with attached Finding of No Significant Impact (FNSI) or Notice of Intent (NOI), as appropriate, in accordance with Paragraph 5-5, AR 200-2.

e. requires a "Notice of Intent" (NOI) to prepare an Environmental Impact Statement (EIS), in accordance with paragraph 6-5, AR 200-2.

Name (PRINT) James Lariviere

Signature _____ DATE: _____
(PROFONENT OF ACTION)

Ofc Symbol, Bldg No. & Telephone/Fax see below

Name (PRINT) James Lariviere

Signature LARIVIERE.JAMES.A.1265731542 DATE: 10/5/16
(ORGANIZATIONS ENVIRONMENTAL POC)

Ofc Symbol, Bldg No. & Telephone/Fax RDRL-LOA-T, 205-0233, building 4600 hdb 3388

6 Name (PRINT) JOE AMBROZEWICZ

Signature Joseph Ambrozewicz DATE: 24 OCT 16
(APG ENVIRONMENTAL COORDINATOR)

Ofc Symbol, Bldg No. & Telephone/Fax 1MHP PWE BLDG 4304 410 2771576

(SEE ATTACHED COMMENTS)

Proponent signature certifies that proponent shall ensure all statements, requirements and conditions are met. The REC is void if action has taken place prior to APG Environmental Coordinator's signature date. The APG signature certifies that this REC is the appropriate level of NEPA documentation for this action.

IMNE Form 1221-R, 01 Oct 08 (Edition of 01 Jun 07 is obsolete)

Fig. 1 REC APGR 200-1²



Fig. 2 Erosion of shoreline at EF 15, Spesutie Island, and (photo-enhanced) location of proposed block-wall placement



Fig. 3 Example of concrete blocks for EF 15 break wall

After additional consideration and options of control methods, a Living Shoreline was the method approved for stabilization of the shoreline. Jade Creek Construction, LLC, was contacted by the ERG for a site visit, site plans, and ultimately a cost estimate. Afterward, a site plan must be approved through the Maryland Department of the Environment and the US Army Corps of Engineers. Figures 4–6 show Jade Creek’s post-site-visit opinions and comments regarding the shoreline damage, methods, and remediation efforts (3 pages).³

January 10, 2017

West Leg, Spesutie Narrows Shoreline

The Spesutie Narrows shoreline bordering the Army Research Laboratory (ARL) EF 15 range is a low bluff, with an average shoreline height less than two feet above mean high water. The center of the subject shoreline is a mown grass area that surrounds the test area. Unmaintained scrub-shrub and second growth tree cover border the subject shoreline reach to the North and South. The concave shoreline has a Western exposure and is experiencing several feet of erosion annually. Shoreline erosion is focused within the center of the arch, with the trailing edges to the North and South showing greater stability.

Located on the "West Leg" of Spesutie Island; within the Spesutie Narrows, the subject shoreline is a strong candidate for a conventional living shoreline remedy. Compliant with current Maryland Department of Environment guidelines; the subject shoreline erosion control strategy should include a near shore sill (no higher than the existing shoreline) backfilled by a nourished beach profile consisting of unsorted cobble stone, sand and organic peat. The organic peat provides a growth medium on the landward portion of the beach fill.

Aberdeen Proving Ground has performed extensive Wind, Wave, Fetch Length, Water Depth and Shoreline Erosion and design analysis in support of earlier stabilization projects. Previous studies and completed shoreline reaches provide templates for design and real-life points for observation of success and design improvements.

The remedy proposed for stabilization of the EF 15 Shoreline is anticipated to include the following components:

- Three 50' near-shore sills, centered on the EF 15 range, separated by a 25' gap.
- Finished sill height to match existing shoreline.
- Beach nourishment (sand and cobble fill) placed from landward toe of sill to match the grade of the existing shoreline. (Beach nourishment placed to cover the entire length of the eroding "bluff" associated with the mown grass and feathered to the north and south in a smooth transition to existing grade).

Means, methods and construction material details:

- Woven geotextile fabric beneath near shore sills.
- Base Layer of stone over geotextile, 8" to 1' typical.
- Largest stones selected for seaward placement.
- Armor stones in contact but not chinked.
- Sill layout will follow existing shoreline.
- Beach nourishment with cobble stone and sand blend; organic peat layered at landward extent of nourishment.
- Anticipate approximately 200 cy of beach nourishment.
- Total square feet of nourishment: 3750
- Total bottom coverage of sill footprint: 1200 sf
- All materials placed from land based construction positions, i.e. no barge import or operations.

Figures 1 and 2 show shoreline (with ebb & flow) and sill cross section. These and similar figures required for MDE and COE permit applications.

Fig. 4 Remediation plan for EF 15 shoreline (reprinted with permission of Jade Creek Construction³)

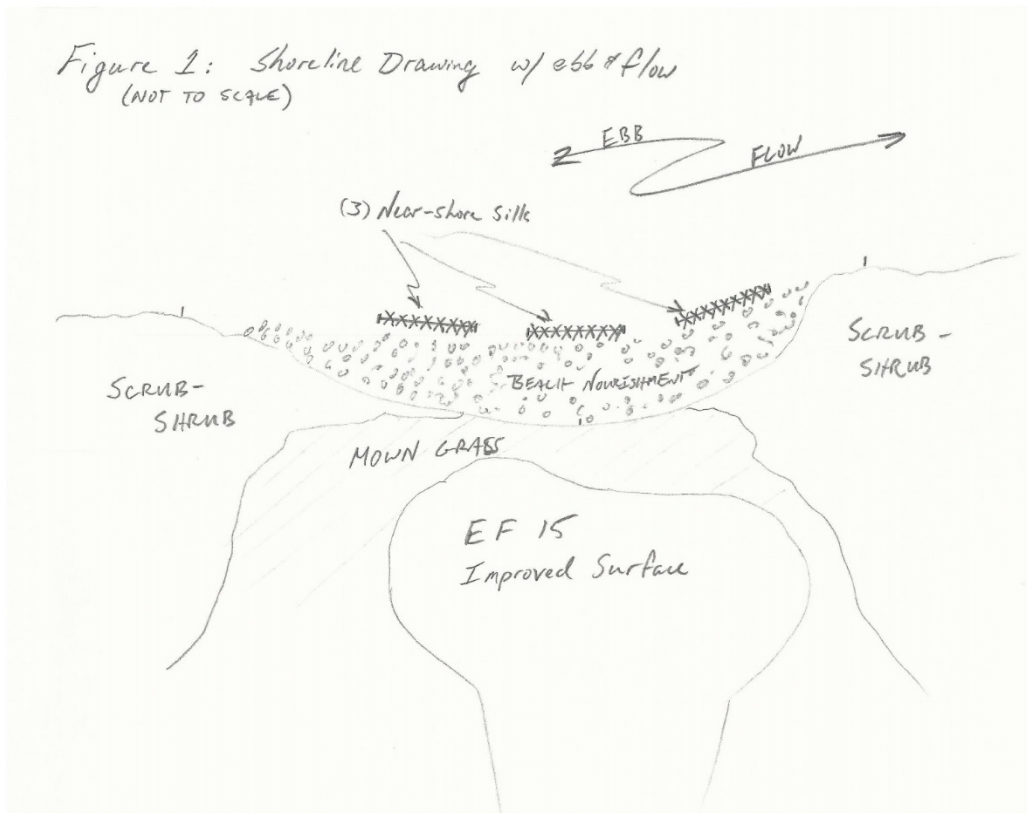


Fig. 5 Sketch 1 of remediation plan for EF 15 shoreline (reprinted with permission of Jade Creek Construction³)

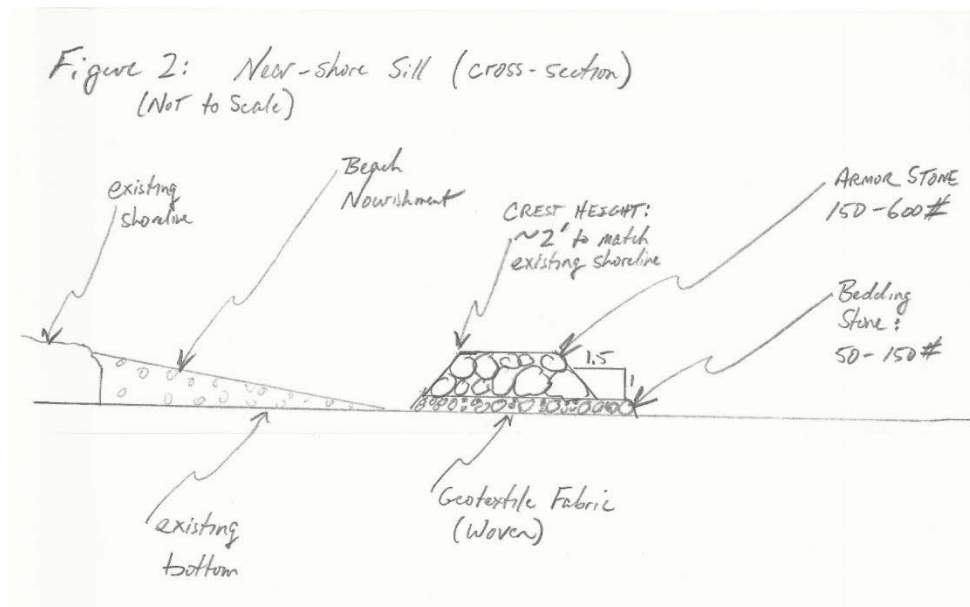


Fig. 6 Sketch 2 of remediation plan for EF 15 shoreline (reprinted with permission of Jade Creek Construction³)

5. Results

Initial cost estimates for the proposed work from Jade Creek Construction were \$90,000–\$120,000. After a site visit was performed and a site plan drawn up, cost estimates had approximately doubled to \$225,000, which included surveying, explosive-ordnance support, site work, and project management. This cost estimate was forwarded to ARL's Weapons and Materials Research Directorate (WMRD) for consideration. Because of the high cost estimate and WMRD funding priorities, other routes of payment were researched, specifically 219 funding through APG Garrison and an environmental upgrade consideration list through the Installation Management Command.

6. Conclusion

In closing, 2 viable plans for funding are still on the table for EF 15 remediation; but, because of the increase in costs, the stabilization of the shoreline may have to be put on hold until future funding is approved.

7. References

1. Wikipedia. Coastal erosion. [accessed 18 and 29 June 2017]. https://en.wikipedia.org/wiki/Coastal_erosion.
2. Lariviere J. Record of Environmental Consideration, APGR 200-1. Personal communication, 2016 Oct 5.
3. Ebrite J. Jade Creek Construction, LLC, Manassas, VA. Personal communication, 2017 Jan 10.

List of Symbols, Abbreviations, and Acronyms

APG	Aberdeen Proving Ground
ARL	US Army Research Laboratory
EF 15	Experimental Facility 15
ERG	Environmental Research Group
REC	Record of Environmental Consideration
WMRD	Weapons and Materials Research Directorate

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